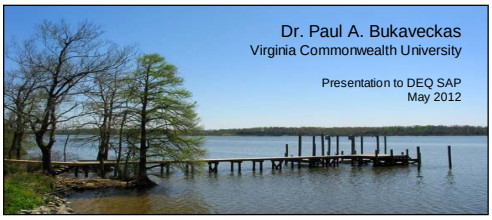
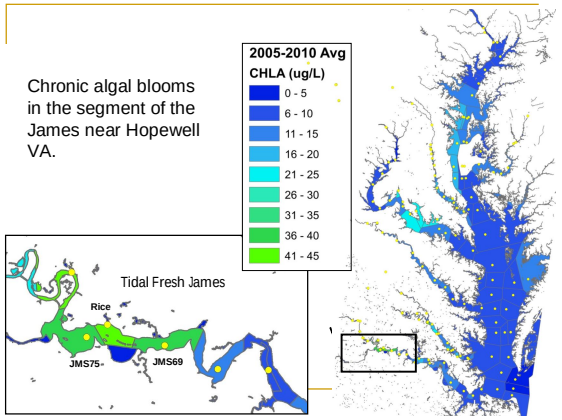
2011 Monitoring of Tidal-Freshwater James River



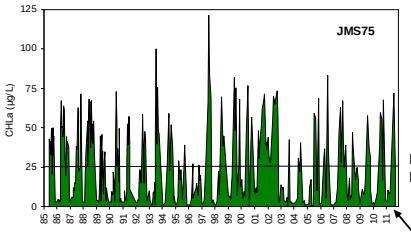
Dr. Paul A. Bukaveckas
Virginia Commonwealth University

Presentation to DEQ SAP
May 2012

Chronic algal blooms in the segment of the James near Hopewell VA.



CHLa Long-Term Time Series

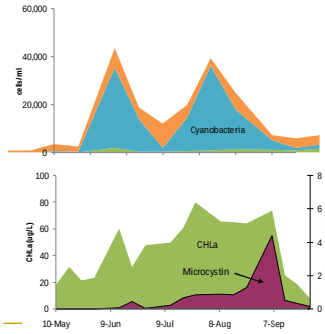


Long-Term Annual Mean = 25.4 µg/L

2011 Mean = 23.8 µg/L

Source: VA DEQ CBP Monitoring

Harmful Algal Blooms (JMS75)

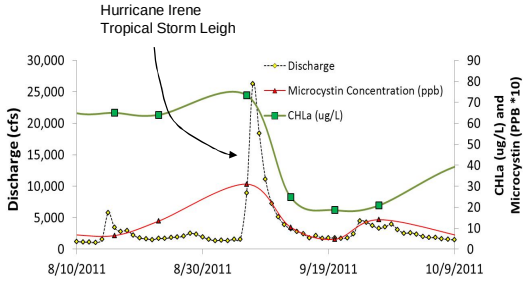


Cyanobacteria abundance data from Harold Marshall, ODU.

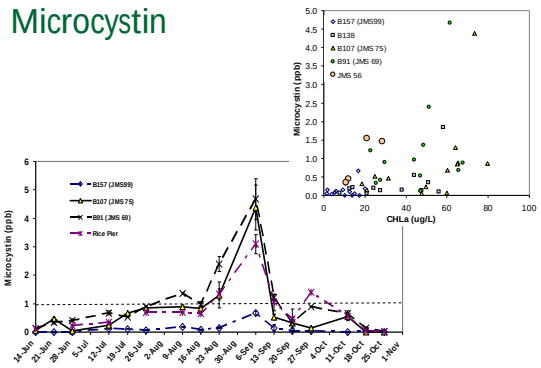
WHO standards for MC

- drinking = 1 µg/L
- contact = 5 µg/L

The End of the Bloom



Microcystin



2012 Data Collection Activities for Tidal-Freshwater James River

Virginia Commonwealth University
PIs: Bukaveckas, Garman, & McIninch

Updated May 2012

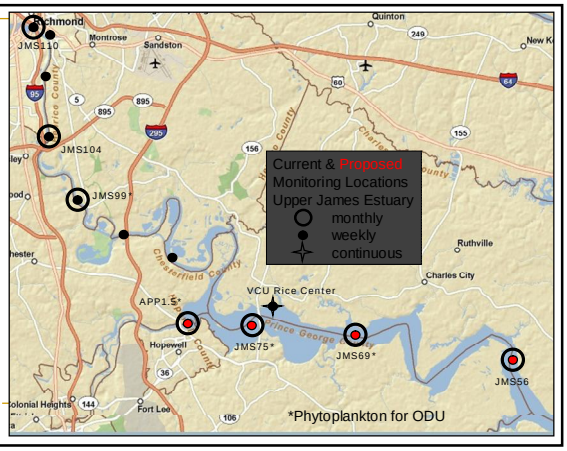
VCU Scope of Work for 2012

Objective 1. Characterizing algal blooms in the Upper James River.

- Sub-task 1.1: spatial and temporal dynamics of algal blooms in the tidal freshwater James River.
- Sub-task 1.2: environmental factors that promote algal blooms.
  a. role of nutrient limitation
  b. role of grazers

Sub-Task 1.1. Characterizing the Spatial and Temporal Dynamics of Algal Blooms

- Monitoring algal blooms in the region where CHLa is highest (rm 55-75).
  - Weekly sampling at 4 stations that are currently sampled monthly by DEQ.
  - Samples analyzed for CHLa, nutrients, Microcystin. Samples provided to ODU for phytoplankton enumeration.
  - Sampling conducted June through October = 17 collections (excludes weeks of DEQ sampling).



Monitoring Sites & Parameters

Site	Water Quality	Nutrients	Chlorophyll a	Phytoplankton (ODU)	Microcystin	Algal Bioassays	Micro: Ecoli, Fcoli	Micro: Live/Dead	DIC, DOC, POC/PON	MIB, Geosmin	Continuous Water Quality
Huegenot	√	√	√				√	√	√		
Mayo's (JMS110)	√	√	√				√	√			
CSO	√	√	√				√	√			
B168	√	√	√				√	√			
B166 (JMS104)	√	√	√				√	√			
B157 (JMS99)	√	√	√	√	√		√	√	√	√	
B150	√	√	√				√	√			
B138	√	√	√		√		√	√			
B8 (APP1.53)	√	√	√	√	√					√	
B107 (JMS75)	√	√	√	√	√	√	√	√	√	√	
Rice Pier	√	√	√		√	√			√		√
B91 (JMS69)	√	√	√	√	√				√		
B74 (JMS56)	√	√	√		√				√		

Sub-Task 1.2. Environmental Conditions Favoring Algal blooms.

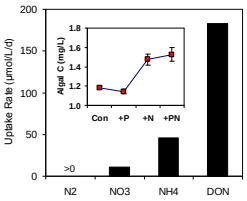
Light vs. Nutrient Limitation

N vs. P, NO_3 vs. NH_4 vs. DON

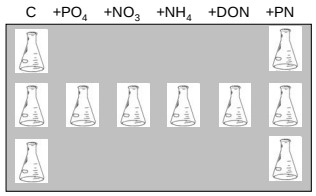
Monthly experiments (June–Oct) using water collected at Rice Pier & JMS75.

Cultures: 50% raw river water + 50% filtered river water.

Response variables: algal growth rates (CHLa, POC), nutrient uptake (N,P), HAB response (Microcystin, phycocyanin).



Algal Bioassay Experiments

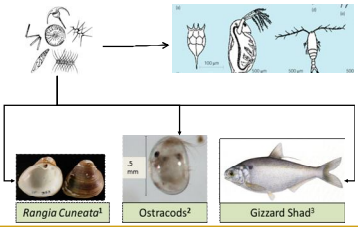


3 replicates each; ΔCHLa and ΔPOC measured after 48 h
Rice Pier: Full design. JMS75: Control, +PN only.

Sub-Task 1.2. Role of Grazers in Controlling Algal Blooms

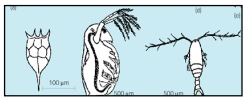
Community Grazing Rate = GR Consumer$_1$ + GR Consumer$_2$ + …

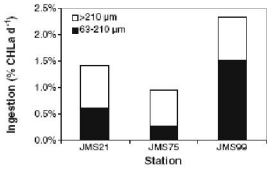
GR Consumer$_1$ = % algae in diet x feeding rate x abundance



Year 1 Objective: Who are the important consumers of suspended and sedimented CHLa in the tidal freshwater James River?

Zooplankton Grazing in James River





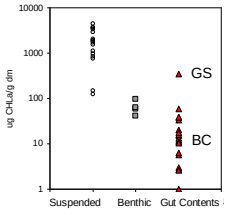
Measured grazing rates low, typically <5% CHLa/d.

Typical values for estuaries are ~30% CHLa/day.

Focus in Year-1 on fishes and benthic filter-feeders.

From Bukaveckas et al. 2011 Estuaries and Coasts

Fish as Consumers of CHLa



CHLa content of suspended PM, benthic PM and fish gut contents.

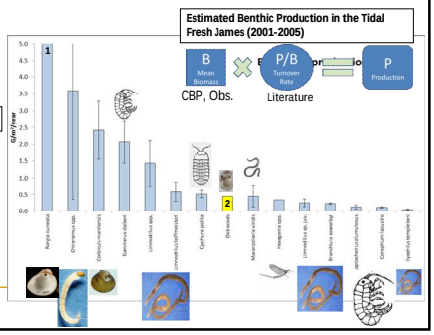
- Monthly (June-Oct) electrofishing to obtain 15 individuals for each target group: Atlantic menhaden, gizzard & threadfin shad, juvenile blue cats (0-15 & 15-30 cm).
- Gut contents analyzed to determine %CHLa in diet (=CHLa/dry mass).
- Based on results, propose further work (Y2&3) to measure feeding rates and abundance.

Grazers of Importance – Benthic invertebrates

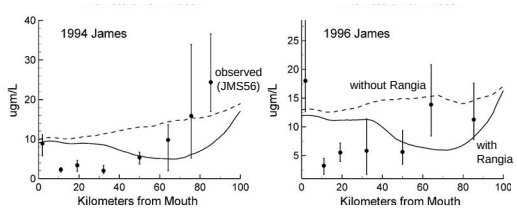
Data from CBP annual surveys include 3-5 sites sampled 1-3/y in t-f James (Dan Dauer, ODU).

*Rangia Cuneata*¹

Corbicula



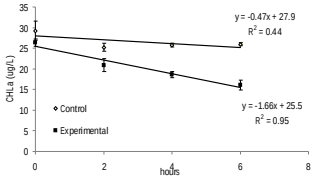
Prior Work on Filter-Feeding Mussels in t-f James based on Model Simulations



Modeling analyses of the effects of Rangia on CHLa in the James River (from Cerco & Noel 2010).

Top-Down Effects: Rangia (Sub-Task 1.2)

- Monthly experiments (June-Oct) using clams and water from James incubated for 24 h at ambient river T (16-32° C) and Standard T (20° C).
- Measure reductions in suspended particulate matter to estimate per capita feeding rates (as net clearance of TSS, POC, CHLa mg/ind/d).



Objective 2. Assessing impairments associated with algal blooms.

- Sub-Task 2.1: What is the occurrence of cyanotoxins (Microcystin) in water, sediments and the food web of the tidal freshwater James River?
- Weekly monitoring of Microcystin in water during June – October at JMS99, 75, 69 and 56, Rice Pier and APP1.5.
- Monthly monitoring of MC in surficial sediments collected from two near-shore areas adjacent to JMS75 (Rice, Tar Bay) and one upstream (reference) location (Presquile or Jones Neck).

Sub-Task 2.1: Microcystin in Biota

- Monthly monitoring (June-Oct) of MC accumulation in target species that are important components of the food web:
  - Macroinvertebrates (2 targets): Rangia, blue crabs.
  - Fish (4 targets): Atlantic menhaden, gizzard shad, juvenile and adult catfish.
- 10 individuals per group per month (as available); analyses include liver and muscle.

Summary Year 1 (2012) Activities

- Sub-Task 1.1: Characterizing algal blooms
  - Weekly monitoring of CHLa, nutrients, and phytoplankton.
- Sub-Task 1.2a: Algal Bioassay Experiments
- Sub-Task 1.2b: Grazer Effects
  - Monthly fish gut contents
  - Rangia Grazing Experiments
- Sub-Task 2.1: Microcystin Monitoring
  - Weekly water
  - Monthly sediments & biota